SCIENCE.

FRIDAY, APRIL 9, 1886.

COMMENT AND CRITICISM.

THE RISE AND FALL of the waters in the northwestern lakes, and the consequent dangers to the lake cities, have frequently been a sensational subject for discussion. The great tidal waves, like the one which rolled in on Cleveland a few years since, and the piling-up or lowering of the waters by continued gales, are, of course, real dangers on account of the suddenness of their occurrence, though, happily, they are rare and temporary events. But alarmists are continually announcing the discovery that the gradual or secular changes in the lake-levels are sure to bring disastrous results. According as the waters are rising or falling, we hear of grave fears that some lake-post is likely to be inundated, or left high and dry inland. Recent reports in the daily press indicate that Lake Michigan is assuming a threatening attitude towards Chicago and its suburbs. The lake is now rising, the reports state, at the rate of several inches per year; and one needs only to imagine this rise prolonged at the observed rate for a few years to get an idea of startling possibilities for the Garden city. But the records of the fluctuations in water-level of the Great Lakes, which have been carefully kept for many years by the corps of engineers, U.S.A., do not warrant us in prolonging any observable rise or fall indefinitely. On the contrary, these records indicate that the variations in the lake-levels, above or below the mean stage, are confined to a very few feet, — about three feet at the most. The variations are greatest in Lake Ontario, less in Lake Erie, still less in Lakes Huron and Michigan, which form a single level surface, and least of all in Lake Superior. With reference to Lake Michigan in particular, a glance at the water-level curves published in the report of the chief of engineers, U.S.A., 1882 (the curves do not appear to be published in the later reports), shows that the average yearly variation in level of that lake is about one foot, that the maximum variation during any one year included in the period (1859–82) covered by the published record was two feet and a half, and that the extreme fluctuation during the same period from the highest stage (in 1859 or 1876) to the lowest stage (in 1869 or 1873) was three feet and seven-tenths. The highest recorded stage of Lake Michigan, viz., that of 1838, was only one foot higher than the stage of 1859 or 1876. It seems tolerably safe, therefore, to conclude that the prospective dangers to Chicago or any of the lake cities from too much or too little water in the lakes are all such as may be overcome by acts of congress in the shape of timely items in the river and harbor bill.

THE OUTLINE-MAP of the United States in four sections, prepared by Dr. A. B. Hart of Harvard, and lately issued by D. C. Heath & Co., may be a means of leading the numerous teachers of history throughout the country to adopt more scientific methods of instruction. On this account alone, and wholly apart from its intrinsic excellence, it deserves recognition and notice. The map is in four sections, each thirty-one by forty-four inches, the United States being divided at the 37th parallel and at the 95th meridian. Being in outline, and showing the principal water-courses, a skilful teacher can, without any great ability as a draughtsman, color the map so as to present in graphic form geological facts or the course of political and social development. Changes of population, the local strength of political parties, the distribution of railways, schools, or industrial establishments, topographical features, — in short, any thing which admits of statistical and graphic presentation, — can be shown with a minimum of expense and labor. The map is so cheap that a teacher can easily procure a number of them; and, when once colored to illustrate any particular subject, they can be rolled up, and used again at any future time.

We would suggest that the principle here applied by Dr. Hart to United States geography and history will bear extension. The map should be reproduced on a smaller scale for the use of pupils; for, by copying the display-map on an outline of his own, the facts will be more deeply impressed upon the student's mind, and he will always have a graphic summary of them for reference. We shall soon hope to see outline-

maps of Europe on the same plan. Nothing could throw more light upon the mazes of mediaeval and modern French, and particularly German history, than such a method of illustration as is here offered. Where the pupil now possesses an unmanageable congeries of facts, names, and dates, he could then carry away with him a vivid picture of the intricacies caused by the constant series of wars and dynastic contests. These maps are virtually the object-method applied to history, social science, geology, ethnography, and their related sciences. They are in every way commendable, and no teacher of those subjects should fail to apply the method which they suggest.

ALTHOUGH SENATOR ALLISON'S commission which is investigating the surveys reported the evidence taken some weeks since, no conclusions have yet been made public. Nothing officially authenticated can therefore be said as to what legislation the commission will finally recommend. But those who have most closely followed the proceedings, and watched the effect of the evidence upon the minds of the members, feel entire confidence that no very radical measures will be proposed, and especially that the integrity of the coast survey will not be threatened. It is scarcely believed that the commission will even recommend its transfer to the interior, or any other department than that under which it is now placed. The impression that no change will be made has become so wide-spread, that candidates for the position of superintendent are again coming forward. The friends of Gen. W. F. Smith are said to be the strongest, but it is not well to predicate any thing upon newspaper reports of the prominence of Smith, Rosecrans, or any other candidate. It is safe to say that the President is fully conscious of the importance of the position, and of the small value to be attached to recommendations secured by the candidates themselves. We believe that he will make the best selection he can from the names presented to him, disregarding their influence, and that the standing of the candidates as scientific experts will not be disregarded in the choice.

ELECTRIC RAILWAYS.

AMERICA seems to lag very much behind Europe in the matter of electric railways. Indeed, our lighting systems seem to have absorbed all our energies; and perhaps the most appropriate and lucrative use of dynamic electricity, its application to locomotion, has been overlooked, or been treated in so superficial a manner as not to have resulted in commercial success.

Every American supposes himself capable of intuitively doing his own engineering, regardless of the fact that he may have neither experience in any of its various departments nor education in the fundamental facts and methods of computation of technological application of scientific truths. Inventors with good ideas regarding electrical work gravely spin for us complete systems for electrical railways, drawing only on their intuitions for every thing save the dynamos and motors. Do they realize that a vast number of problems of organization and system still remain unsolved upon the steam-railroads? Do they realize that they are not engineers, but only electricians, with a vast deal yet to learn in their own field? They do not: they are in possession of one good idea, and they recklessly proceed to surround their invention with all sorts of engineering crudities, thus rendering their chances of success almost nothing.

Germany has been more fortunate in having its first electric railway undertaken by Siemens & Halske. This firm brought to bear upon the problem the profound researches and the engineering education of its staff, and, acting in the cautious and thorough manner resulting from its wide experience in many fields of engineering, has been successful. In the exhibition of Berlin, 1879, they established a circular railway of 350 metres length, one metre gauge, and, placing a three-horse power motor in a car capable of carrying thirty people, transported passengers at a rate of fifteen to twenty miles per hour. The current was taken along one rail, and by an insulated tire was conveyed to the positive pole of the motor, and thence to the other rail, by which it returned to the generating-dynamo. No special care was taken to insulate the rails, which were placed high above the ground on wooden ties. The current was of low electromotive force, and therefore did not require special means for insulation. This road was exhibited in Düsseldorf and Brussels, and finally in London in 1881.

The success of this experimental plant was uniformly so great as to make Messrs. Siemens & Halske desirous of building an elevated electric railway in Berlin, for which the plans and estimates were made with great care, but unfortunately this enterprise was not carried out, because the Emperor William would not permit 'The Linden' to be marred by being crossed at one point, and because the citizens objected to having people looking into their second-story windows.

The carefully made estimates of this road may be of interest as showing the minimum of cost of good work, upon the authority of engineers thoroughly conversant with their profession.

ELEVATED RAILWAY IN BERLIN, ONE METRE GAUGE, 6¼ MILES LONG, WITH SEPARATE MOTOR FOR EACH CAR.

Railway structure and 10 stations		$305,000
10 carriages, seating 15 persons each		15,750
Steam-engine, boilers and dynamos		9,750
Buildings		5,925
Land		22,500
General labor		3,575
		$362,500
Current expenses.		
Wages	$10,950	
Fuel	5,550	
Oil and waste	250	
Lighting	400	$17,150
Depreciation and repairs: —		
3% on $312,500	$9,375	
16% on $25,000	4,000	13,375
Interest on capital ($377,500) @ 5%		18,875
		$49,400

It was proposed to run two hundred trips each day at a fare of two cents per mile, and would have proved a paying investment had it obtained the equivalent of six passengers for a whole trip for each car.

Failing in this, Messrs. Siemens & Halske obtained a charter for a surface electric railway from the Berlin military academy to Lichterfelde, a distance of a mile and a half, which was opened in May, 1881. This road was constructed upon the ground after the manner of ordinary roads, save that a bowed fish-plate connected the rails so as to permit contraction and expansion. Again, only two rails were used, — one conveying the current out from the dynamo, and the other returning the current to the dynamo. Very little resistance was found, owing to the large cross-section of the rails used as conductors, and consequently low potentials were found practicable. Very great success has attended the running of this road, and it has been extended to Tetlow and Potsdam, making, in all, some eight miles of road in successful operation upon ordinary roadbed with wooden ties and steel rails. Insulated wheel-tires are used to take off the current.

At Paris the law required flat tram-car rails, not projecting above the street-level; and the presence of dirt would have interfered with the passage of the electric current from the rails to the wheels: so overhead copper conductors, and trolleys running along the conductors, and connected to the car by flexible wires, were used. In the mines at Zankerode, Prussia, Messrs. Siemens used two overhead rails for conductors, as the condition of the track prevented its use. A separate motor, weighing a ton and a half, drew loads of eight tons at a rate of seven or eight miles per hour. In other cases, Messrs. Siemens & Halske have found it advisable to use a third rail, or separate copper conductor connected with the positive pole of the generating-dynamo, and have connected the negative pole with one or both rails of the roadbed. The Portrush and Bush mills electric railway, six miles long, has used a third rail so placed as to be free from dirt, and has been in successful operation for several years. Besides the Portrush railway, there are now in successful operation electric railways at Brighton and Blackpool. Dupuy, at Lisieux, France, has arranged a locomotive for use in the bleaching-fields of a bleaching-works. The power is carried in Faure accumulators on the locomotive. Recently we have the experiments upon the Reckenzaun secondary battery tram-car at the Antwerp exhibition, which proved itself the superior, in many ways, of the steam and compressed-air motors entered in competition with it. When we compare the indicated power of the engine charging the secondary batteries with the power developed in moving the car, we find an efficiency of from thirty to forty per cent in this case. It is impossible to doubt the ultimate success of electric railways when built with sufficient knowledge and engineering skill to assure their adaptation to the purposes which they must subserve. The successful outcome of the work of Siemens & Halske prove this beyond a doubt. The possibility of attaching a motor to each car enables us, with very little loss of space, to have each car independent of any separate locomotive, and to utilize the adhesion of all the wheels, and load. The counter electromotive force of a dynamo used as a motor, being proportional to its speed, renders it to a certain extent automatic; so that, being at rest, the current passing is the most intense, the torsion is a maximum, and the car starts with a great pull. If the car slows on an up grade, the pull at once increases, and, if it goes faster on a down grade, the counter electromotive force increases, the intensity of the current diminishes, and the demand for power upon the generating-dynamo and engine is reduced. The application of power to each car avoids the necessity of an extremely heavy locomotive, and allows of a great diminution of the weight and strength of bridges and viaducts.

A large number of electric railways have been projected in this country, and some tried with a moderate degree of success, as at Toronto, New Orleans, Baltimore, and other places. The ex-

periment which has of late attracted the most attention has been the substitution of electricity for steam on the New York elevated railways. That this experiment has not succeeded as well as could be wished is not due to any inapplicability of electricity to the purposes of locomotion. All that has been attempted in New York has been successfully carried out in Germany, and a more careful copying of the details and methods of Messrs. Siemens & Halske would have produced success. The enormous traffic on these roads taxes to the utmost the carrying-capacity of the steam-plant, which is the result of half a century of study and modification of machinery of locomotives and cars. The substitution of electric motors for steam-locomotives will be a gradual process, and will progress just in proportion to the engineering skill brought to bear upon the problem. W. D. MARKS.

CARTWRIGHT LECTURES ON PHYSIOLOGY.

WHILE physiological science has made rapid advances in recent years, there are still many problems which it has as yet failed to solve, notwithstanding the fact that many patient and skilled investigators have devoted their entire time and energy to their solution. Among these problems, none is of greater interest and importance than the life-history of the blood, and to its elucidation the best minds in Europe and in this country have been directed. Prof. William Osler, M.D., of the University of Pennsylvania, was invited to deliver the fifth course of the Cartwright lectures of the Alumni association of the College of physicians and surgeons of New York, and selected as his subject, 'Certain problems in the physiology of the blood.' The course of these lectures began the evening of March 23, at the hall of the Young men's Christian association.

The first lecture dealt with the blood-plaque, which is also known as the elementary corpuscle of Zimmerman, the haematoblast of Hayem, the third corpuscle and blood-plate of Bizzozero. In blood withdrawn from the vessels, in addition to the red and white corpuscles, are seen grayish granular masses, being from ten to fifteen times the size of a red corpuscle. These are known as Schultze's granule masses. They are made up of small bodies, which are of uniform size, and, seen in face, have a disk shape, and in profile appear as rods. These bodies are the blood-plaques. Their diameter is from 1.5 micro-millimetres to 3.5 micro-millimetres. They are always found in mammalian blood, though their number is subject to considerable variation, in health averaging one to twenty red corpuscles. The estimates of their number, made with the haemacytometer, give about two hundred and fifty thousand of them to each cubic millimetre of adult blood. In the new-born this may be doubled, as also in consumption. In fact, in all wasting diseases their number is much increased, as not only in consumption, but also in cancer and in anaemia; and they appear sometimes to occupy nearly the whole field of the microscope. During acute fevers they are much diminished in number, and again increase during convalescence.

When the blood is withdrawn from the blood-vessels, these plaques have a tendency to conglutinate, forming the granule masses of Schultze; and so rapidly does this occur, that it would appear to be the condition in which they exist while within the vessels. This is, however, not the case, but is a property which they possess analogous to the nummulation of the red corpuscles. That this state of conglutination is not the natural one may be shown by examining the blood while circulating in a living animal, as in the omentum of a guinea-pig or rabbit, or in the subcutaneous tissues of a new-born rat, which is admirably adapted to the purpose. Or, if a drop of a solution of osmic acid (one per cent) or Pacim's fluid be placed upon the tip of the finger, and then the finger pricked, so that a drop of blood will flow directly into this solution, and then the whole transferred to a microscope-slide and examined, it will be found that the plaques are isolated, and the tendency to coherence has been overcome.

There are some investigators who hold to the opinion that these blood-plaques are disintegrated white corpuscles, but the objections to this explanation are numerous and incontrovertible. It may therefore be considered as established that the blood-plaque is a separate entity, and distinct from the mature red and white corpuscle.

The history of these corpuscles may be divided into three periods. In the first, prior to 1877–78, a number of investigators were at work upon it, among them Donné, Zimmerman, and Erb. In 1874 Osler pointed out that the granule masses of Schultze only formed after the blood was withdrawn from the blood-vessels. In the second period, 1877–78, Hayem demonstrated the existence of this third corpuscle, and called it haematoblast. In 1882 additional researches were made by Bizzozero, who described it as a blood-plate. In the third period, from 1882 to the present time, a number of investigators have been at work, and there have appeared some twenty different articles upon the subject. Kemp has been investigating the question at the Johns Hopkins university, and his paper will contain a full bibliography.

The second lecture in the course was delivered March 27, and treated of the degeneration and the regeneration of the corpuscles.

In our study of the blood, we find that there are factors constantly at work to maintain its histological uniformity, but as to these processes our knowledge is still very imperfect. In some conditions, as during fever, anaemia, and after hemorrhages, the number of the red corpuscles is very much diminished. In profound anaemia there will be found in the blood the normal red corpuscle, certain small corpuscles to which the name microcytes has been given, and larger ones, known as megalocytes. In addition to these, are very irregular forms known as poikilocytes. In atrophy of the stomach the condition of microcytosis, in which the microcytes abound, is very marked. The interesting question concerning these forms is, Are they young cells on their way to the formation of the red corpuscle, or are they degenerated red corpuscles on their way to disintegration? Hayem considers that first in order come the blood-plaques, and then the microcytes: Osler, on the other hand, believes them to be degenerated corpuscles, fragments of the old ones. In anaemia, where the irregular shape of the corpuscles is marked, or the condition of poikilocytosis, as it is termed, this may go on to such a degree as to lead to the separation of small particles; and this suggests a possible origin of the microcytes. They may also be formed from the red corpuscles by fission and budding, as may be seen in the red marrow of the bone.

The megalocyte may be studied in anaemia induced by hemorrhage. It has a diameter twice that of the red corpuscle, fourteen millimetres: it is not usually circular nor biconcave, but flattened and irregular. In these cases of induced anaemia by hemorrhage, the white corpuscles are increased in number, both relatively and absolutely; and, as we have already learned, the blood-plaques are increased. In severe anaemia or leukaemia we may find nucleated red blood corpuscles, which are normally formed during foetal life, in the new-born, and up to the age of four or five years. One of these may be seen in every three or four fields. These corpuscles in various stages of development may be studied in the red marrow of the bone, as the vertebrae and the ribs of the child and embryo. Here we find a small solid cell or nucleus; next, this with a layer of translucent protoplasm; next the protoplasm becomes colored, and we have a nucleated red corpuscle. The nucleus gradually disappears and disintegrates, giving us the non-nucleated red corpuscle. Rindfleisch thinks the nucleus emigrates from the corpuscle, but Osler thinks this is a post-mortem change when it occurs. Some authorities regard these extended nuclei as the blood-plaques. Bizzozero describes a process of fission in the red corpuscle by which it becomes two cells, and thus explains the formation of new corpuscles, those that undergo fission being direct descendants from the embryonic red corpuscles. Hayem regards the blood-plaques as becoming the red corpuscles. In cells which are to be seen in lymph-glands, in the spleen and the bone-marrow, are oftentimes to be found red corpuscles, which some regard as on their way to degeneration: others look upon them as being new cells. In this intracellular production of the red corpuscles, Osler is a believer.

The third and last lecture of Professor Osler, in the Cartwright course before the Alumni association of the College of physicians and surgeons, was delivered on March 30, and dealt with 'The relation of the corpuscles to the process of coagulation.'

The views of Buchanan, published soon after 1830, that the coagulation of the blood was dependent upon the white corpuscles, which acted like a ferment somewhat as rennet does in the coagulation of caseine, had for many years been forgotten and ignored. Schmidt of Dorpat, and his pupils, later elaborated these views of Buchanan. They considered that the white corpuscles furnish fibrinoplastine or paraglobuline, and a ferment, while fibrinogen exists normally in the plasma of the blood; that the white corpuscles, in furnishing these two elements, undergo disintegration and destruction.

Woolridge has, within the past few years, maintained that the white corpuscles play an important part in the formation of fibrine. He has been able to procure leucocytes, or colorless corpuscles, from the lymph-glands; and when these corpuscles, to which has been added an equal volume of a ten-per-cent solution of salt, are placed in peptone-plasma obtained from the blood of an animal into whose vessels peptone has been injected, coagulation at once takes place. The quantity of fibrine which is thus produced depends upon the number of leucocytes added. These corpuscles seem to form the fibrine, and the weight of the fibrine is the same as that of the leucocytes added. The albumen undergoes no change, while examination shows that the leucocytes have undergone disintegration.

The formation of fibrine in the blood may be studied in the moist chamber. The time at which the process commences varies from fifteen seconds to two minutes. Before coagulation commences, all the corpuscles can be easily distinguished; and Osler has never seen any appearance indicating

that the fibrine filaments were formed by a disintegration of the white corpuscles. On the other hand, these corpuscles seem to be stable elements. As a matter of fact, no observer has claimed ever to have seen the actual change of a corpuscle into fibrine.

The process of coagulation can also be studied in a fine capillary tube. The clot forms in the centre, and the serum outside. The white corpuscles seem to be squeezed out of the clot, or to migrate from it.

Landois, whose observations were made some ten years ago, thinks that the red corpuscles are connected with the formation of fibrine.

But the most interesting of all the problems is the relation of the blood-plaques to this process of coagulation. In blood drawn from the vessels we see fine filaments shooting out radially from the granule masses of Schultze, — those masses which we have already learned are collections of the blood-plaques. Ranvier, in 1873, regarded these as the centres of fibrine formation. The fibrine certainly does stand in a thick, dense network about these masses. In healthy blood, fibrine also appears entirely independent of the plaques. The filaments are fine, and appear much like margarine crystals. These filaments may be especially dense near the plaques; but any one can satisfy himself, by examining the blood in the moist chamber, that the fibrine forms independently of them as well. If we pass a ligature through the femoral vein of a dog, and allow it to remain for five minutes, particularly if we have separated the threads of the ligature, and then examine it, we shall find it coated with blood-plaques. If the blood of a dog is received into a cup, and this is whipped with a brush of threads for five minutes, we have the same aggregation of the plaques upon the threads: some white corpuscles will also be found, but the plaques are the striking feature. If these threads are dipped into a solution containing a coagulable substance, clotting will at once take place. The greater the number of blood-plaques, the denser and firmer will be the clot.

Still more instructive and interesting is the study of thrombosis, or clotting in the blood-vessels. If a dog is bled to death through a cut in the femoral artery, and the vessel excised and placed in osmic acid, and subsequently examined, we shall find on the cut edges and in the lumen of the vessel a finely granular material, and outside of this a darker mass composed of red corpuscles. The inner portion, the finely granular material, however, which is in contact with the elastic lamina, is composed of blood-plaques, and not white corpuscles. These plaques are the first elements or factors in the formation of a thrombus. Eberth, in Virchow's 'Archives,' has just shown that the first elements to settle and to lodge on lacerated vessels are blood-plaques. In all white thrombi these plaques seem to make up their bulk. If a needle is passed through a blood-vessel in the omentum of a living animal, the first elements which collect at the point of injury are the blood-plaques, and a distinct white thrombus is formed. These observations on the relation of the plaques to coagulation have been made by Bizzozero, Hayem, and Eberth.

In the circulating blood the plaques keep with the red corpuscles. If we examine a vessel of the omentum of the rabbit or guinea-pig, we shall see only a red streak, which occupies the central part of the vessel. In the space between this and the wall of the vessel, in the still layer as it is called, we may occasionally see a few colorless corpuscles. If the circulation now becomes slower, we shall see the plaques in the still layer with these colorless corpuscles. If atheromatous ulcers of the aorta are examined, it will be found that the material which has collected upon them is made up of blood-plaques: the same is true of the vegetations found upon the valves. While the distinct plaque form is apparent in the superficial parts of these structures, and the same is true of white thrombi, the deeper parts are also plaques, but in a granular state of disintegration.

Eberth has shown, that while, in the rapidly circulating blood, the corpuscles and plaques are together, yet, if acid is placed on the edge of a vessel or laceration, the plaques collect, and form a definite aggregation or white thrombus. We frequently find in autopsies atheromatous ulcers or calcareous plates which have no thrombi: in these cases, the circulation during life having been rapid, the plaques remained central; but, as the current becomes slower, these plaques become peripheral, and adhere to surfaces denuded of endothelium, and thrombi result.

LONDON LETTER.

IMPORTANT changes are in progress at Oxford which will give the university a real faculty of medicine. It has hitherto conducted medical examinations for graduates in arts who have obtained their professional education elsewhere, generally at one of the great London hospitals. But in future Oxford men will be able to enter the university as medical students, as has long been the case at Cambridge. It will still be necessary for them, however, to graduate in arts, which will practically mean in the school of natural science, before they can proceed to a medical degree; and,

as the exemption of natural science men from the classical examination known as 'moderations' will shortly come into operation, there will be no difficulty in this respect. A skilled anatomical teacher, Dr. Arthur Thomson, has been imported from Edinburgh; and the names of Profs. Bayley Balfour, Burdon Sanderson, and H. N. Moseley, are a sufficient guaranty that the preliminary training in botany, physiology, and zoölogy will be thoroughly efficient.

In the person of Mr. C. W. Peach, another member of the good old school of British naturalists has passed away. He began life as a coast-guardsman in the preventive service, and soon acquired an intimate knowledge of the marine fauna of the south of England. When not engaged in detecting smugglers, he devoted his energies to zoölogical and geological studies, and was rewarded by the discovery of many new species among the lower invertebrates, and also, a point of much more importance, of traces of fossil fishes in the Devonian rocks of Devonshire. Later on he received an appointment in Scotland, and his discovery of fossils in the altered rocks of the highlands proved to be one of the utmost value in the skilled hands of Sir Roderick Murchison. Mr. Peach's great powers of observation and rich store of knowledge were always at the service of professional scientific men. Lyell and Murchison, Forbes and Carpenter, Gwyn Jeffreys and Wyville Thomson, and many others, who are happily still with us, knew and valued him highly. His son, Mr. B. N. Peach, is a distinguished member of the geological survey of Scotland.

The American friends of the late Dr. Thomas Davidson may like to know that a fund is being raised by the mayor of Brighton for the purpose of placing some memorial of him in the museum of that town. It was the object of his constant care during the many years that he resided at Brighton, and it is felt that his services in the cause of science deserve some permanent commemoration. His library and large collection of brachiopods are now in the Natural history museum at South Kensington.

Some important statements which have been recently made in the house of commons indicate that the government is going to form a department of the board of trade which shall do for England what the fishery board of Scotland and the Irish commissioners of fisheries do for Ireland. It is hoped that this may be the first step towards the establishment of a definite board of British fisheries, analogous to the department of botany at Kew, the geological survey office, and other similar institutions. At the present time the English fisheries are not under the supervision of any professional naturalist whatever, and their interests suffer in consequence.

Although February last was the coldest on record in England, the first ten days of March were colder. Only once in that period, viz., at the Scilly Islands, off the south-west corner of England, was 50° F. recorded at any station in the British Isles. Nothing above 43° was recorded in London in that period, and from Feb. 19 to March 11 there was a frost every night in London. Though March, 1883, was the coldest March but two of this century, 52° was recorded on March 5 of that year. On March 19 the frost suddenly broke up, terminating the twenty-four days' continuous skating which had been enjoyed in a northern suburb of London; and since then the weather has been very mild.

The results of the experiments in the Pasteur laboratory are being watched with the keenest interest. One of the Russian moujiks, who had been bitten by a mad wolf, has died, but the others show no sign of disease. The children and other patients sent from Bradford (Yorkshire) have returned thither, and are loud in praise of the treatment they have received. It is rumored, as a result of the question in the house of commons mentioned in the last London letter, that the government intends to appoint a royal commission to investigate the question. The names of Sir James Paget, Sir W. Jenner, Dr. Lauder Brunton, Prof. Burdon Sanderson, and Sir H. Roscoe, are mentioned in this connection.

A very crowded audience assembled a few nights ago to hear a paper upon domestic electric lighting, by Mr. W. H. Preece, head of the electrical department of the general post-office. He expressed the opinion, that, although England was beaten by so many countries in the adoption of arc-lighting, she probably led the way in the domestic use of incandescent lamps. These, however, were all private and separate installations, many instances of which were given. The electric lighting bill of Lord Rayleigh, introduced into the house of lords on March 19, would, if it became law, remove the disabilities imposed by the act of 1882. Although the nomenclature and efficiency of glow-lamps was in a very unsatisfactory state, enormous improvements had been made in the dynamo since the expiration of the patent monopoly. It was now the most perfect existing converter of energy, and was one-third the price, and its output was trebled: hence it was nine times better than it was a few years ago, during the existence of the patent. A lively discussion followed the reading of the paper.

Mr. W. H. Christie, the astronomer royal, recently lectured at the Royal institution on uni-

versal time, in the course of which he paid a high compliment to the railways of the United States and Canada for having reduced the number of local times from seventy-five to five, by adopting the five standard meridians. The scheme of hourly meridians, however, could only be considered a provisional arrangement, which would ultimately lead to the adoption of universal time, for which he thought the name 'world time' would be the best. The 'world' day would commence at Greenwich, midnight, and count from 0 h. to 24 h. Among the authorities cited by Mr. Christie in support of the twenty-four hours system, was that of the president of the Western union telegraph company (U.S.A.), who considered, that, in addition to diminishing risk of errors, it would save the cost of a hundred and fifty million letters annually. W.

London, March 27.

NOTES AND NEWS.

THE fourteenth annual meeting of the American public health association will be held at Toronto, Ont., Oct. 5–8, 1886. The executive committee have selected the following topics for consideration at said meeting: 1. The disposal of the refuse matters of cities and towns; 2. The condition of stored water-supplies, and their relation to the public health; 3. The best methods and the apparatus necessary for the teaching of hygiene in the public schools, as well as the means for securing uniformity in such instruction; 4. Recent sanitary experiences in connection with the exclusion and suppression of epidemic disease; 5. The sanitary conditions and necessities of school-houses and school-life; 6. The preventable causes of disease, injury, and death in American manufactories and workshops, and the best means and appliances for preventing and avoiding them; 7. Plans for dwelling-houses. The local committee of arrangements at Toronto, Ont., have already actively begun the work essential to a large and successful meeting. In addition to the usual work incident to such an undertaking, they will extend invitations to foreign sanitarians, and secure such transportation facilities as will probably insure a good representation from abroad. Communications regarding matters of transportation or of a local character should be addressed to Peter H. Bryce, M.D., chairman local committee of arrangements, Toronto, Ont. Mr. Henry Lomb of Rochester, N.Y., who is already well-known through the prizes which he gave last year for the best essays on certain sanitary subjects, offers for the present year the sum of seventeen hundred and fifty dollars, to be awarded as prizes on the following subjects: 1. The sanitary conditions and necessities of school-houses and school-life, one prize, $500; 2. The preventable causes of disease, injury, and death in American manufactories and workshops, and the best means and appliances for preventing and avoiding them, one prize, $500; 3. Plans for dwelling-houses, — (*a*) A plan for a dwelling-house not to exceed in cost, exclusive of cellar, eight hundred dollars (prizes: first, $200; second, $100; third, $50; fourth, $25); (*b*) A plan for a dwelling-house not to exceed in cost, including the cellar, sixteen hundred dollars (prizes: first, $200; second, $100; third, $50; fourth, $25). Accommodations to be provided for families consisting of five persons. All essays and plans for the above prizes must be in the hands of the secretary, Dr. Irving A. Watson, Concord, N.H., on or before Aug. 15, 1886.

— The officers of Section D (mechanical science and engineering) of the American association for the advancement of science have issued a circular stating that the steadily increasing interest and importance of the meetings of Section D justify the expectation of a large attendance of engineers at the Buffalo meeting. The meetings of the American association offer to students of mechanical science and to engineers opportunities which cannot be elsewhere obtained, of conveniently meeting at one time a large number of gentlemen eminent in branches of science to which engineering is closely related, especially mathematics, physics, chemistry, geology, and economic science. The scope of this section is broad enough to include all branches of engineering. It occupies a field peculiar to itself, which by no means encroaches upon that of the various engineering societies, but rather adjoins and supplements it. These societies deal chiefly with accomplished practical results, while Section D affords an opportunity for the presentation and discussion of papers upon the application of scientific methods to every department of engineering. The object of the section, in accordance with the name of the association, is the 'advancement of science.' The following may be named as among the general classes of subjects which this section may properly consider within its scope: mechanical science in the abstract; mechanical research; problems in engineering of national importance, and such as are connected with more than one branch of engineering; the education of engineers; the relation of the government to engineers in civil life; the endowment and organization of mechanical research. The officers extend a cordial invitation to all to attend the meetings of the section, and to contribute such papers or discus-

sions as will aid in furthering its objects. It is requested that all who intend to contribute papers will notify the secretary (William Kent, 92 Reade Street, New York) as soon as possible. The committee on the best method of teaching mechanical engineering, — Prof. J. Burkitt Webb, Prof. George J. Alden, Dr. Calvin M. Woodward, and Prof. Arthur Beardsley, — and the committee on the use and value of accurate standards, screws, surfaces, and gauges, — Prof. William A. Rogers, Mr. Oberlin Smith, and Prof. J. Burkitt Webb, — are expected to present reports at the Buffalo meeting.

— The fish commission steamer Albatross arrived at Nassau, New Providence, March 19, after a most successful trip. The ship was chiefly engaged in making soundings. Two naturalists were landed at Watling's Island, San Salvador, where much valuable scientific material was gathered during a stay of two weeks. But little dredging has been done, so that few accessions of marine life have been made. At Rum Cay, Conception Island, Cat Island, and Great Exuma Island, the naturalists of the expedition obtained many valuable specimens of fish, lizards, bird's-nests, eggs, cave relics, pottery, and about five hundred bird-skins. These islands are very small, and thinly populated. Vegetation is scarce, and the islands themselves are formed almost entirely of rock. Cocoanut-trees and bananas are abundant, but oranges and apples rather scarce. The Albatross is now at Key West, and will spend some time dredging in the Gulf of Mexico and vicinity.

— General Hazen said recently, in his testimony before a congressional committee, that foreign signal stations were a necessity, and the establishment of a station in the West Indies had fully demonstrated this fact. It is quite probable that congress will authorize the establishment of stations at important foreign points.

— The commissioners of the District of Columbia have refused the gift of Judge Pacificus Ord, of a tract of land along Rock Creek for a zoölogical garden. The grant was made on the express condition that the property should be used for a free zoölogical garden and free public baths, to be kept by officers created by congress for that purpose. The commissioners think there is no present need of a zoölogical garden or bath-house, nor have they the means to establish them.

— The U. S. fish commission is busily engaged in stocking the Great Lakes with white-fish. Cars Nos. 2 and 3 are now at Northville, Mich. About April 15 the shad distribution will begin. The eggs are hatched at the Fort Washington station, and shipped to the central station of the commission at Washington, the distribution being made from there. The distribution of carp has ceased for this season, as it has been found impracticable to ship these fish after the first of March; the young carp developing fungus, and becoming emaciated.

— No less than forty-four wrecks appear on the April number of the 'Pilot chart' issued by the hydrographic office. Some were seen in January, but the greater number are reported from observations late in February and through March. Three recent cases of disastrous collision with sunken wrecks are quoted. It is announced that the vessels of the National line, including all the cattle-steamers, have made arrangements for the regular use of oil in rough weather.

— The bark Flora (Spanish) reports that on March 21, Cape Hatteras, bearing W.S.W., distant thirty-five miles, three very large seas came up from astern [vessel probably heading north], and in passing caused the vessel to roll deeply. At the time the sea was very smooth, and became so again immediately after the passage of the heavy swells. There was a light breeze from S.S.W. The captain says he never saw or heard of such an occurrence before. On p. 266, vol. ii., of the 'Voyage of the Challenger,' Sir Wyville Thomson says, "It must be a wonderful phenomenon, an enormously heavy swell arising in a perfectly calm sea, without any apparent cause, and breaking against the leeward coast of the island (Ascension) with almost irresistible fury."

— A bottle was found floating near the beach at Colon, on the 1st of February. It had the appearance of having been some time in salt water, and was found to contain two papers on which was written as follows: "Lat. 12° 47′ N., Long. 24° 47′ W., noon, Saturday, 20th December, 1884; ship Patriarch 69 days out from New Castle (N.S.W.), and bound for London; all well."

— The New York *Evening post* states that "the treasury commission for investigating the coast survey have addressed a communication to the secretary of the treasury in which they say, 'In the light of the demonstrated inaccuracy of some of the evidence upon which the committee relied, and to the extent hereinbefore indicated, it is but just to admit that the criticism of Mr. C. S. Peirce in the committee's report was unwarranted by the facts.' It is understood to be admitted that Mr. Peirce's expenditures were overstated, and his work undervalued. The only criticism the committee continue to maintain is, that he

practically conducted his operations as he saw fit. His work has been done under detailed instructions issued by the superintendent of the survey, and these instructions have been based upon projects which Mr. Peirce was required to submit each season. We will only add that this finding is what every one acquainted with Mr. Peirce must have expected as the result of a calm and unprejudiced examination."

— Telegrams received from Professor Pickering announce the discovery of three new asteroids by Dr. Palisa of Vienna. The first was discovered on March 31, and was of the thirteenth magnitude; the other two, on April 2 and 3, of the thirteenth and twelfth magnitudes. These three will receive the numbers 254, 255, and 256 respectively, and will raise the whole number discovered by Dr. Palisa to fifty-three.

— The programme for the second half of the course of lectures under the auspices of the Anthropological and biological societies of Washington is as follows: Saturday, April 10, Dr. Washington Matthews, U.S.A., The gods of the Navajos; Friday, April 16, Dr. D. B. Simmons, Social status of the women of Japan; Saturday, April 24, Prof. W. K. Brooks, Life; Saturday, May 1, Mr. Lester F. Ward, Heredity and opportunity; Saturday, May 8, Dr. J. S. Billings, U.S.A., Animal heat.

— The series of summer schools of the Monteagle (Tenn.) assembly is announced to open on June 30, and continue to Aug. 25. The scientific instruction in chemistry, geology, and botany, will be under the charge of Prof. J. I. D. Hinds.

— We cut the following from the Atlantic 'Pilot chart' for April: "Mr. J. H. Barker, an oil-merchant of New York, informs the branch hydrographic office that he has the contract with, and since Jan. 1 of this year has furnished, the National line of steamships with oil to be used to lessen the dangerous effects of heavy seas. Ten vessels, including all the cattle-steamers, have been provided with the necessary appliances to use oil when occasion requires. The company's requisition called for fish-oil, but the recent experiments proved it thickened too rapidly when in contact with water at the general low winter temperatures. To obviate this tendency, Mr. Barker has mixed a mineral oil having a low, cold test, with fish-oil which has a comparatively high test: the result is an oil which coagulates at a much lower temperature than ordinary fish-oil, but which it is claimed will be as efficacious. The mineral oil has stood the test as a lubricant for railroads in cold weather, and it is claimed will be very useful for sea purposes when mixed with a proper proportion of fish-oil, during the mild and warm months fish alone is to be supplied. The method adopted of using oil is by means of punctured canvas bags filled with oakum."

— From numerous experiments on flies, beetles, hymenoptera, neuroptera, and lepidoptera, M. Plateau concludes that insects with compound eyes, with or without simple eyes, pay no heed to differences of form in the light openings of a half-darkened room, but fly with equal readiness to the apparently easy and apparently difficult way of escape; that they are attracted to the more intensely lightened opening or to one with apparently greater surface; and that, in short, they cannot by vision distinguish form, or only to a very slight extent.

— Chief engineer Melville of the ill-fated Jeannette has recently stated that he is still endeavoring to organize another polar expedition, and, although his schemes have met with little success, he will yet continue to work upon them.

— The question of the movements of the ulna and radius of the human arm during the act of pronation and supination has of late provoked considerable discussion among students of anatomy. The view most commonly held and taught, that the elbow-joint is a perfect hinge, and that the ulna remains fixed during pronation and supination, has been disputed by some recent investigators. At the last meeting of the Biological society of Washington, Dr. Frank Baker read a paper upon this subject, in which he concludes that the ulna is capable of considerable lateral movement, and that in pronation and supination both the ulna and radius rotate. Dr. Harrison Allen of Philadelphia has also been studying this question with the aid of instantaneous photographic apparatus, and is said to have reached similar conclusions.

— Harrison & Sons, London, announce 'Physico-chemical constants, melting and boiling point tables,' by Thomas Carnelley, professor of chemistry in University college, Dundee. These tables will contain about fifty thousand melting and boiling point data. The object of the tables is as follows: 1. To present as complete a list as possible of all known melting and boiling point data, and at the same time to indicate which of them is probably the most exact, when there are several determinations referring to the same substance; 2. To state as fully as possible the constitution of each substance to which the data refer; 3. To adopt such a system of ar-

rangement as will facilitate as far as possible the ready finding of the data relating to any given substance ; 4. To give the authority and reference to the original memoir in each case (the tables thus form a catalogue of the literature referring to most chemical substances) ; 5. To give, in addition, the reference, if any, to either 'Watt's dictionary of chemistry,' or to the journal of the Chemical society, for the convenience of those who are unable to refer to the original papers (this is a feature of the work which will doubtless be found particularly useful, more especially to British and American investigators). The tables will be issued in two volumes, of which the first is now ready.

— Prof. Mansfield Merriman of Lehigh university, Pennsylvania, has published a "Key to his text-book on the mechanics of materials." This key contains the answers to the problems in the text-book, and is published in response to inquiries from those who have used the book. The opportunity has also been taken to give the method of solution of a few of the difficult problems.

— The first part of the new zoölogical journal announced by us some time since, to be edited by Dr. J. W. Spengel of Bremen under the title of *Zoologische jahrbücher*, will be soon published, and will contain the following papers, besides shorter notices: Hartlaub, 'Contributions to the knowledge of the species of Manatus ;' Reichenow, 'Monograph of the genus Ploceus, Cuv.;' Bergh, 'The Marseniadae ;' Nehring, 'Contributions to the knowledge of the species of Galictis ;' Frenzel, 'On glycerine preparations.' The price of the part is nine marks. Four parts make a volume. Beside the regular parts, supplementary ones will be issued from time to time for the publication of separate papers too long to appear in the journal itself. The regular subscribers may or may not take the supplements also, as they prefer. The first of the supplements is to appear shortly, and will contain Dr. K. Jordan's memoir on the butterfly fauna of north-west Germany.

— Dr. Patrick of St. Louis has in preparation a work on the mounds of southern Illinois, based upon a large collection of crania and other objects from that region. His report will be issued by the U.S. bureau of ethnology.

— Prof. E. D. Cope of Philadelphia is about to publish a monograph on the recent batrachians and reptiles of North America, as a bulletin of the national museum. It will contain descriptions of all the species so far known, many of which will be figured, together with an extensive discussion of the osteology of the several groups, and a sketch of the soft anatomy of the leading types.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

International copyright.

MR. APPLETON MORGAN, in his letter upon international copyright in *Science* for March 5, says, "While always an enthusiastic advocate of an international copyright as a matter of abstract justice to British authors, I have never been able to satisfy myself of the constitutional right of congress to enact a separate bill for the purpose of effecting one." I do not intend to attempt, in this letter, to convince Mr. Morgan that the enactment of such a bill would be constitutional, but I think it may not be without interest to the readers of *Science* to point out that the passage in the constitution which grants congress the power to "secure to authors and inventors the exclusive right to their respective writings and discoveries" has been expounded to mean, of necessity, *all* authors and inventors, without regard to nationality.

Edward L. Andrews, E-q., as the representative of the Copyright association, argued before the senate committee on the library, in 1872, that, as American authors were not specified in this clause, the word 'authors' must be taken to mean all authors, wherever resident, and therefore the constitution "in this respect is mandatory in its character." But Mr. Andrews was not the first person to argue this construction of the constitution. Thirty-five years earlier this construction had so distinguished an advocate as Mr. Henry Clay. During the copyright agitation of 1836–37 in England, certain British authors sent to the United States an 'address' containing a petition to congress to grant to them "the exclusive benefit of their writings within the United States." This petition, which bears the signatures of fifty-six authors of England and Ireland, — a remarkable list of names, including Carlyle, Disraeli (father and son), Bulwer, the poets Southey, Thomas Moore, Rogers, Campbell, Chalmers and Cunningham, Harriet Martineau and Mary Somerville, besides others equally famous, — was presented to the senate by Mr. Clay on Thursday, Feb. 2, 1837. After calling attention to the distinguished names appended to the document, and explaining that it represented that the works of British authors were published in the United States without any compensation being made to them for their copyrights, and that they were frequently altered and mutilated so as to affect injuriously their reputations, because of which grievances they petitioned the passage of a protective law, he commended the address to the attentive and friendly consideration of the senate, and closed with these words: "Indeed, I do not see any ground of just objection, either in the constitution or in sound policy, to the passage of a law tendering to all foreign nations reciprocal security for literary property." This petition was referred to a select committee, which reported Feb. 16, through Mr. Clay, and asked leave to introduce a bill granting copyright to the authors of Great Britain and France, which was the first international-copyright bill presented to congress. The last paragraph of this report contains Mr. Clay's argument, referred to above, and reads as follows: "With respect to the constitutional power to pass the proposed bill, the committee entertain no doubt, and congress, as be-

fore stated, has acted on it. The constitution authorizes congress 'to promote the progress of science and useful arts by securing, for limited times, to authors and inventors, the exclusive right to their respective writings and discoveries.' There is no limitation of the power to natives or residents of this country. Such a limitation would have been hostile to the object of the power granted. That object was to *promote* the progress of science and useful arts. They belong to no particular country, but to mankind generally. And it cannot be doubted that the stimulus which it was intended to give to mind and genius — in other words, the promotion of the progress of science and the arts — will be increased by the motives which the bill offers to the inhabitants of Great Britain and France."

I believe that the view expressed by Mr. Morgan in the last paragraph of his communication is correct, and that a "Bill to amend the Revised statutes relating to copyrights" — amending section forty-nine hundred and fifty-two by striking out the words 'citizen of the United States, or resident therein,' and substituting the word 'person;' amending section forty-nine hundred and fifty four by striking out the words 'and a citizen of the United States, or resident therein;' amending section forty-nine hundred and sixty-seven by striking out the parenthetical clause '(if such author or proprietor is a citizen of the United States, or resident therein);' and repealing section forty-nine hundred and seventy-one — would secure to foreign authors protection over their works equal to that now granted to citizens or residents. It is really in this way that the bill introduced into the senate by Mr. Hawley grants protection to the works of foreign authors; the first section being in reality a limiting provision, stipulating that the protection is only granted to authors of such countries as confer equal rights of protection to citizens of the United States, in other words a reciprocity clause. By mistake, the Hawley bill neglects to provide for the amendment of section forty-nine hundred and fifty-two, though careful provision is made for the amendments necessary in the other sections.

Thorvald Solberg.

Washington, D.C., March 30.

The distinction between anatomy and comparative anatomy.

It was not so many years ago that even those holding the highest positions in the profession of medicine regarded human anatomy as the only anatomy entitled to the name, and that comparative anatomy meant something else altogether. Its teachings were not appreciated by the vast majority of those who studied the anatomy of man, and the great surgeons of those days were rather inclined to look askant at one who indulged in researches into the structure of the 'lower animals.' But in these days such matters wear a very different aspect, for anatomy means morphology, — the knowledge of the structure of organic forms, — both living and extinct, and it is rarely indeed that we hear of any one attempting to draw hard and fast lines between the anatomy of man, and either any of his own class or other representatives of the Vertebrata.

Thanks to the progress biology has made during the last quarter of a century, all literature that has any thing to do with such subjects, actually teems with the teachings of morphology. Such being the case, one is rather disposed to regard with some measure of surprise the classification that so excellent a work as the *Index medicus* adopts for its record of such subjects. In its last issue, for instance (February, 1886, p. 54), and I believe it has always adhered to the same plan, it makes one section for anatomy, histology, and embryology, and a subsection for comparative anatomy and embryology. Now, in the section-in-chief, we find entered the recent admirable paper by Dr. E. C. Spitzka, on 'The comparative anatomy of the pyramid tract,' the contribution evidently being considered as an 'anatomical one;' while we find awarded to the subsection Retterer's article entitled "Sur le développement des tonsilles chez les mammifères," to say nothing of all the anatomical articles from the last number of the *Journal of anatomy*, of London.

Now, as fully the larger share of Spitzka's memoir is devoted to the study of the pyramid tract in other animals than man, it would seem, even according to the plan adopted by the *Index medicus*, that that essay has not fallen into its proper section. The same stricture applies, for a similar reason, to Retterer's paper. Surely it would seem better to have one section devoted to morphology, to include all contributions that refer to the structure of organic forms, and, if necessary, two subsections, — one devoted to histology, and the other to embryology.

R. W. Shufeldt.

Fort Wingate, N. Mex., March 30.

Penetrating-power of arrows.

You doubtless have read of the wonderful feats of archery said to have been performed by savage archers. Cabeça de Vaca, for instance, tells us that the good armor of the Spaniards was no protection against these missiles. Some of the men swore that they had seen two red oaks, each the thickness of the lower part of the leg, pierced through from side to side by arrows. I myself saw an arrow that had entered the butt of an elm to the depth of a span. The same author states that the corpses of the Spaniards were found to have been traversed from side to side by arrows. An instance is given, where an arrow shot by an Indian pierced through the saddle and housings, and penetrated one-third its length into the body of a Spaniard's horse. These quotations from Jones's 'Southern Indians' might be increased to any number, covering a period from the Homeric age to our day, all showing the popular belief concerning the power of the arrow.

I desire very much to induce our archery clubs to institute a series of careful experiments upon the following points: —

1. How far can an arrow be shot in a calm? How far with or against a moderate calm?

2. What is the greatest distance at which an arrow can be shot with any degree of accuracy? Experiments should be made both as to the vertical and horizontal.

3. What is the momentum of an arrow leaving a bow? (Tested by shooting against a disk attached to a graduated scale.)

4. What is the penetrating power of an arrow into animals? This may be tried with horses, cattle, or dogs, which have just died, or with those in an *abattoir* just about to be slaughtered.

5. The register of the bow as to length, etc., and

a description of the arrow used, should be carefully preserved.

As soon as possible, I shall publish an account of the bows and arrows in the national museum, and shall be more than pleased to collate and preserve the results of careful experiments as a basis of comparison with the archery of savages. It is generally conceded that the archery clubs, with their much better artillery, achieve higher averages in shooting than could be attained by the aboriginal bowmen.

O. T. MASON,
Curator of Dept. of ethnology.
Smithsonian institution,
March 31.

Underground rivers.

In an article in *Nature* (Jan. 14, p. 246) entitled 'Curious phenomena in Cephalonia,' a former pupil of Ledger writes, "The sea runs into the land in a strong stream, turning a water-wheel on the way, and disappears in the earth about a hundred yards from the entrance. . . . I imagine that this water must be converted into steam, which comes out either at Naples or at Stromboli." Prof. Henry S. Williams of this university called my attention to this quotation, and to its indirect connection with what follows. The writer, while passing through Yucatan, Mexico, in 1870, saw a large stream running with torrential speed within a natural tunnel not far from the seashore, and probably over one hundred feet below the surface of the ocean. These underground rivers, which are said to be numerous in the neighborhood of the city of Merida, are called *zanates* (Thah-n'ah-tess) by the inhabitants of Yucatan. I had time to visit only one of these remarkable subterranean rivers. Its shaft-like entrance was adorned by a picturesque old Spanish well-curb of stone, furnished with standards of fancifully forged iron-work. Nothing on the surface indicated the existence of the vast cavern under the monotonous and flat lowlands of the peninsula of Yucatan; and, though not a breath of air stirred, the deafening roar of the torrent under our feet could not be perceived until we were fully inside of the cave. A rapid descent brought us to the level of the pumps used for irrigating a very extensive *ixtle* plantation; and from here we could see, by the light of our torches, the yellow foam of the waters upon the undefined background of the chasm below. Descending still farther, the full stream could be seen through a wide fissure in the limestone of the cave. It had the rounded appearance of a stream flowing horizontally under great pressure, ten or twelve feet in diameter, and looking like a gigantic black icicle lying on its side. This large volume of water plunged with great swiftness into an unexplored and dark chamber with terrific roar, and producing noises which resembled the hollow echoes of heavy explosions heard now and then above the perpetual rumbling of the rushing water. A visit to this cave cannot fail to produce a very deep impression, and not unlike the feeling which renders so imposing the unpleasant experience of an earthquake.

The manager of the plantation informed me that the mouth or entrance of this *zanate* was only twenty-eight feet above the Gulf of Mexico; and since my barometer indicated a descent of a hundred and forty feet, if the information was correct, this stream was delivering, within forty miles from the seashore, a volume of fresh water about a hundred and twelve feet below the level of the sea. The temperature of the water was 52° F., and is said to remain constant throughout the year. Only a small portion of the stream was visible; and the direction of the current was N. 60° W. I could obtain very little additional information in reference to the other *zanates*, of which the natives speak with almost religious reverence as "great miracles which have always been as they are now."

Since the velocity of the water, as well as the form of its cross-section, can leave no doubt that the delivery takes place under a considerable head, it would be quite important to ascertain the location of its source, and learn why this cave does not fill up to within twenty-eight feet from the surface, if the stream communicates with the sea. This latter circumstance seems to prove that the elevation given by the manager of the plantation may be incorrect; but, besides the fact that the belief in the great depth of these *zanates* below the ocean is current among the cultivated people of Merida, the manager of the plantation insisted on the correctness of his figures, which were obtained by the instrumental surveys connected with the irrigation of his large estate, the waste water from which runs into the sea. It would seem desirable, therefore, to ascertain through the columns of *Science* if any one else has visited these *zanates*, and has satisfactory data bearing upon this question.

A study of the soundings made by the U. S. coast and geodetic survey upon the Bay of North America; the erosions showed by the stereographic model of the Caribbean Sea, made by Capt. J. R. Bartlett, U. S. N.; the gravimetric work conducted by Professor Peirce of the coast survey; and the hydraulic problems connected with the delta of the Mississippi River,—seem to involve problems related to the Gulf Stream which make desirable a better knowledge of these truly remarkable subterranean rivers.

E. A. FUERTES.
Ithaca, N.Y., March 30.

Note on the nocturnal cooling of bodies.

An interesting application to this subject may be made, by way of supplement, of the principles and expressions contained in my letter on the temperature of the moon (*Science*, vi. No. 150). According to these, the rate with which a body radiates heat is to that with which it receives and absorbs heat from a complete enclosure as μ^{θ} is to $\mu^{\theta'}$, in which $\mu = 1.0077$, and θ and θ' are the temperatures of the body and of the enclosure respectively on the centigrade scale. In this case we necessarily have for the static temperature of the body, that of the enclosure remaining constant, $\theta = \theta'$; but, in the case of an incomplete enclosure, the body, at the same temperature, radiates more heat than it receives and absorbs from the enclosure, and consequently its static temperature is less than that of the enclosure, since it cools down until the rate with which it radiates heat is equal to the rate with which it absorbs heat received from the enclosure.

In the case of a thermometer exposed near the surface of an earth without an atmosphere, the earth's surface would form the half of a complete enclosure, since it would subtend a solid angle equal to that of a hemisphere. In this case the thermometer would receive no heat from the enclosure by re-

flection, but only the radiated heat; and the rate with which the bulb, if spherical, would radiate heat, would be to that with which it would receive and absorb heat as μ^{θ} to $\frac{1}{2} r' \mu^{\theta'}$, in which r' is the relative radiating power of the earth's surface. Hence for the static temperature of the thermometer, that of the earth's surface being supposed to be stationary, we should have

$$\mu^{\theta} = \tfrac{1}{2} r' \mu^{\theta'}, \text{ or } \theta - \theta' = 300 \log \tfrac{1}{2} r'.$$

In case of a maximum radiating power of the earth's surface, in which case $r' = 1$, we have

$$\theta' - \theta = -300 \log \tfrac{1}{2} = 300 \times 0.301 = 90^{\circ} \text{ C.}$$

for the difference between the temperature of the earth's surface and that of the exposed thermometer, the latter being the less. It is seen that the difference is the same, whatever the temperature of the earth's surface. According to this result, if the temperature of the earth's surface were maintained at 0° C., that of the thermometer would be −90° C., if the law of Dulong and Petit can be extended to so low a temperature.

If the earth's surface were polished silver, and of the ordinary temperature, the temperature of the thermometer would be nearly that of absolute zero. If we suppose that the earth's atmosphere, when clear, radiates and reflects back to the body four-fifths as much heat as the body radiates into it, then the enclosure, comprising the earth's surface on the one side, and the atmosphere on the other, lacks one-tenth of completeness, and we then have from the preceding expression,

$$\theta' - \theta = -300 \log 0.9 = 300 \times 0.046 = 13.8^{\circ} \text{ C.}$$

for the difference between the temperature of the earth's surface and that of the thermometer, in case the thermometer received no heat by convection and conduction from the surrounding warmer air. In the case of Melloni's cups, the former of these is prevented, and hence the thermometer in these stands at a lower temperature than one does suspended in the open air, where the colder air immediately in contact with the thermometer-bulb falls down, and warmer air takes its place.

Supposing the atmosphere and the earth's surface to furnish nine-tenths of a complete enclosure to a body near the surface, then, at an altitude which leaves one-half of the atmosphere below it, they would furnish something more than 0.7 of a complete enclosure; for the amount of heat escaping into space is not quite proportional to the mass passed through, especially in the case of dark heat. We should have, in this case,

$$\theta' - \theta < -300 \log 0.7, \text{ or } 46.5^{\circ} \text{ C.},$$

in case of no convection and conduction; but these, of course, would diminish the difference very much. This result, in comparison with the preceding one, explains the low temperatures of bodies at night, when exposed in the air on high mountains a little above the earth's surface, so as to receive no heat from contact with the surface.

The greater the altitude, the more nearly would the difference approximate to 90° C., and would sensibly reach it at a point leaving no sensible portion of atmosphere above it, and even surpass it if the point were so high as to sensibly diminish the subtending solid angle.

The whole of the earth's surface, of course, cools considerably during a clear night; but this only continues until a temperature gradient is formed by which heat is conducted from the lower strata to the surface as fast as it is radiated into the atmosphere. This state, however, can be only approximately reached, and, if the night were continued, the cooling would still go on; but the rate of cooling becomes very small in the latter part of an ordinary night, and much less in that of a polar night. Bodies exposed in the open air, of course, receive no sensible amount of heat by conduction of heat through the air up to the bodies, and so their temperatures fall much lower than that of the earth's surface, and the differences are given by the preceding conditions.

WM. FERREL.

Maori poetry.

An example of Maori poetry may be interesting to some of your readers. The first is a modern Maori love-song composed by a young native and sent to his sweetheart. I am indebted to Mr. C. O. Davis of Auckland, New Zealand, for the translations.

At eventide I lay me down to rest,
As winds from the great ocean pierce my frame.
Come, ye soft northern airs, hasten your speed,
With messengers of love to me. O maiden!
Send me thy epistle to cheer this heart
Of mine, — to dry the tears which freely flow
For thee, O Rosa, absent from thee so long.
When darkness has set in, I rest alone,
The while I fancy thou art present,
And all my thoughts are fettered by thy love.

A maiden's lament on account of the desertion of her lover.

Retire, O sun! and leave the night to me,
While tears, like water, from these eyes are flowing.
The sound of footsteps is no longer heard,
O Taratu! thou comest not again
By way of Waishipa's headlands; still
The sea-fowl show their breasts at Mitiwai,
But my lover lingers in the north,
Binding thyself to thy own landscapes there.
Ah! shall my days of weeping never cease?

C. F. HOLDER.

Pasadena, Los Angeles county, Cal.,
March 21.

Names of the Canadian Rocky Mountain peaks.

As to the naming of the Canadian Rocky Mountain peaks, Mr. Ingersoll may withdraw his correction made upon the authority of Dr. George M. Dawson. Here is an extract from Douglas's journal, under date of May 1, 1827, printed in companion to *Botanical magazine*, ii. 136, in 1836.

"This peak, the highest yet known in the northern continent of America, I felt a sincere pleasure in naming 'Mount Brown' in honor of Robert Brown, Esq., the illustrious botanist, a man no less distinguished by the amiable qualities of his mind than by his scientific attainments. A little to the southward is one of nearly the same height, rising to a sharper point: this I named 'Mount Hooker' in honor of my early patron the professor of botany in the University of Glasgow."

Dr. Hector, "who in 1857–59 was attached to Captain Palliser's expedition," may indeed have named 'Mount Balfour,' curiously sandwiched between the names of Hooker and Brown. Douglas could not well do that, the worthy Edinburgh professor so honored being at that time a lad of nineteen.

A. G.

SCIENCE.—SUPPLEMENT.

FRIDAY, APRIL 9, 1886.

REMARKABLE POWERS OF MEMORY IN THE HUMBLE-BEE.

PROF. EDWARD HOFFER gives in the last number of *Kosmos* a contribution to animal psychology, which will be of interest not only to the entomologist, but to all biologists. It furnishes evidence of some very strange powers of memory of localities, in this group of insects, whose brains, if we may use that term, one would hardly deem capable of such functions.

The author removed a nest containing numerous individuals of one of the common humble-bees (Bombus terrestris) from its original location, and carried it to his residence, about three miles distant. He further carefully watched the place for some time after having captured all those that had flown to the defence of their nest, and secured, it was believed, the entire colony. These he imprisoned for several hours in a wide-mouthed bottle, and safely re-united them in their new home. At his house he placed the nest, with its inhabitants, near a window, and, after they had become quieted, made a small entrance. Immediately they began to fly out, and in doing so must have observed their surroundings, for in a short time they one by one returned. The following night, however, there was a severe storm; and while the inhabitants of the forty other colonies near it, that had become accustomed to their surroundings, were not in the least troubled, these bees escaped, and hid themselves somewhere without during the storm. Upon searching for them early the next morning, the queen was found dead upon the ground, while fifty or sixty of the workers were seen flying about the house. From time to time one or another — probably those which had flown out of the entrance the day before — found the opening, and returned into their nest; while the remainder, after flying about for several hours, gradually disappeared, till not one was left. As it was supposed that they had, in all probability, returned to their previous nest, the place was visited in the afternoon, where, sure enough, at least fifty individuals were found. They had thus, it will be seen, distinctly remembered it, and, after they had sought in vain to find entrance to their new home, they had depended upon their wonderful sense of locality, and returned thither.

A similar instance was observed with another nest, which had been removed a distance of nearly five miles, and in which the same care had been exercised to capture all the individuals. In unskilfully handling the box containing the nest and bees, in its new location, about thirty of the workers escaped, and flew through the open window. After flying for a long time about the house, as though in search of their comrades, they likewise disappeared, and returned to their original nest and again established themselves, as was afterwards ascertained.

It was frequently observed, that, when nests had been removed but a short distance, the workers, during the first few days after their change, would fly swiftly in the direction of their old nest, when, discovering their mistake, they would change their course, and go to their new home. It seemed evident that these little creatures, through some mental process or other, thus discovered their changed circumstances.

In order to test further this remarkable sense of locality, the author marked a number of individuals with oil-colors, and carried them, enclosed in wooden cases, a distance of eight or nine miles, when he allowed them to escape. Very many of them, though not all, found their way back to their nests, and, as a rule, reached home sooner than the author did himself.

The author noticed that at his summer residence, where he had kept numerous hives of these bees, the following spring many individuals appeared, and seemed to be searching for their previous nests; but he was unable to determine whether they were individuals of the previous broods or not. Towards the close of July, 1884, he obtained three nests of Bombus mastrucatus, a large species, only found in the mountains, and especially the higher regions, and carried them to his residence in the city, where he placed them in a window of the second story. The house was enclosed by high buildings, with no garden attached, and yet they returned readily and directly from their excursions to their nests. They throve, and by the first of October had increased to considerable numbers. By the middle of October they wholly disappeared; but, in the early part of the following April, individuals of this species were observed flying about the window, and, as soon as they found an entrance, sought the remains of their old nests, and took up their abode. They remained for a while, when their nest was accidentally injured, and they

left. Nothing more was seen of them till after the author's return from his summer vacation, in the middle of September, when a single female of this species made its appearance. In their inability to obtain an entrance through the closed window, they had evidently built a new nest in the vicinity, and reared their broods.

These circumstances indicate that the intellectual powers of the humble-bee are not as slight as we have been accustomed to believe. Here in this case, from October to April, — a period of six months, — had these bees remained dormant in the ground, or hidden in some crevice, and, upon regaining their activity, had not only remembered the place where they were, but had sought and found, despite the many difficulties, their last year's nest. That these individuals were from the previous year's brood, there was no doubt, as throughout the province the species nowhere else occurs, peculiar as it is to elevated and mountainous regions.

LIGHTHOUSE ILLUMINANTS.

AT the meeting of the London society of arts held on March 10, Mr. E. Price Edwards read a report of the experiments on lighthouse illuminants made at South Foreland during 1884–85. The experiments show that in clear weather all the lights — electric, gas, or oil — were too good, and that for merely sending an effective beam of light to the horizon on a dark, clear night, no one was really better than the other, although it should be said that the electric light used, on account of its dazzling brilliancy, was regarded as a nuisance rather than otherwise by mariners in the near neighborhood of South Foreland. It is quite certain that for clear weather the lower powers of any one of the illuminants would be sufficiently serviceable for the requirements of the mariner.

The oil and gas lamps were rendered thus effective by superposing one upon another series of flames. It was found, that, in respect to the adaptability of the lights for occultations, — one of the distinctive characteristics used for lighthouses, — gas was especially available, as by simply turning off the supply an occultation is promptly produced in an economic and an effective manner; whereas, with the electric or oil lamp, the use of a revolving screen was found most suitable. For colored sectors, on the other hand, the electric light is most serviceable, as, on account of its small surface, the change in color may be made more abruptly.

The general results of the observations in hazy weather show incontestably that a single electric light greatly excels the most powerful oil or gas light in penetrating-power. In an actual fog the electric also holds its own. The experience of fogs at South Foreland was not large, but was sufficient to furnish available comparisons; and it was proved beyond question that the single electric light pierces a greater depth of fog than the highest power available of either gas or oil, but in heavy fogs the mariner would not derive the slightest advantage from any of the lights used. The recorded distances to which lights were carried, or where they were picked up, in heavy fogs, range mostly from seven hundred to two thousand feet; and the superiority of the electric light is determined by penetrating two hundred or three hundred feet farther than the gas or oil light. The most powerful electric light was shut out on one occasion at fourteen hundred and fifty feet, on another at fifteen hundred, another at seventeen hundred, another at fifteen hundred, and another at thirteen hundred feet. It will be plain to all that no mariner could be benefited by a light which was not visible at such distances from the lighthouse; and, for the purpose of navigation, a difference in the visibility of the lights of two or three hundred feet is of no value whatever.

One fact stands out prominently; viz., the greater ratio of absorption by the fog of the electric rays as compared with that of the gas or oil rays. Fortunately for the electric light, as shown at South Foreland, it possesses a large reserve of initial intensity, which enables it, notwithstanding its much greater proportion of loss by absorption of its more refrangible rays, to penetrate farther than the other luminants. With three lights of equal candle-power, — one electric, one gas, one oil, — exhibited in a foggy atmosphere, there is little doubt that the electric will be eclipsed at a much shorter distance than the others. But as an electric beam can be made so much more intense than it is possible to make the gas or oil beam, the electric light, though heavily handicapped by its competitors, by the very superabundance of its own luminous energy, may be made to penetrate the farther.

The experiments have also shown clearly that the lights from gas and oil are very much alike in illumining-power: indeed, under some conditions, the oil-flames seem to be rather the better. They have also shown that the oil-lights can be superposed with the same facility as the gas-lights. As yet, no oil-flame has been brought to the enormous size of the 108-jet burner; but, as this enormous size of flame is not required, the difficulty is of no great consequence. As the two lights were shown to be so nearly equal, the questions of convenience and economy assume

the greater importance in connection with their relative merits as lighthouse illuminants.

The final conclusion of the experimenters was, that, for the ordinary necessities of lighthouse illumination, mineral oil is the most suitable and economical illuminant, and that for salient headlands, important land-falls, and places where a very powerful light is required, electricity offers the greatest advantages.

METAL-WORK OF THE BURMESE.

BOTH Burmans and Shans are expert blacksmiths, says the Journal of the Society of arts. The latter forge all the *dahs* ('native hatchets') used by themselves and their neighbors in the Hotha valley; and they annually resort to Bhamo, and the villages in the Kakhyen hills, for the purpose of manufacturing them. Their bellows are of the most primitive stamp, consisting of two segments of bamboo, about four inches in diameter and five feet long, set vertically, forming the cylinders, which are open above and closed below, except by two small bamboo tubes, which converge and meet at the fire. Each piston consists of a bunch of feathers, or other soft substance, which expands and fits tightly in the cylinder while it is being forcibly driven down, and collapses to let the air pass as it is being drawn up. A boy perched on a high seat or stand, works the two pistons alternately, by the sticks serving as piston-rods. Charcoal is used for fuel.

The casting of large and small articles in brass, bronze, and other alloys, is much practised, always adopting the method known as *à cire perdue*. First a clay model is made, and coated with beeswax to the thickness of the intended cast, and again covered with an outer skin (two inches thick) of clay mixed with finely chopped straw; this latter coat is provided with funnel-like holes, for pouring in the molten metal, at intervals of four inches, and with straw-holes for letting out imprisoned air. Holes are also provided at the bottom for the escape of the melted wax.

THE GREAT SILVER-MINES OF THE WEST.

VALUABLE indeed have been the scientific results which geology has incidentally received through the great mining undertakings of the west. The studies of von Richthofen, of King, and of Zirkel, on the rocks of the Washoe, have been equally welcome to geologists at home and abroad as contributions to the general principles of their science.

The importance of a thorough and detailed geological investigation of regions possessed of great mineral wealth is at once apparent. The geologist may afford the prospector and the capitalist just that information which is most needed; while, in turn, the shafts and tunnels of the latter supply him with sections and exposures of the rocks, which he could never otherwise hope for. How keenly the advantages of such a combination are appreciated by the government geological survey is abundantly proven by the recent elaborate monographs by Becker on the geology of the Comstock Lode, and by Irving on the copper-bearing rocks of Lake Superior; while others of a similar nature are now in course of preparation on the silver districts of Eureka and Leadville by Messrs. Hague and Emmons. Nor may we pass without mention, in this connection, the extremely important contribution recently made by Messrs. Hague and Iddings to what we know of the influence of heat and pressure in conditioning the structure of an eruptive rock. No such conclusive evidence that the holocrystalline structure of an igneous mass depends upon the slowness with which it solidifies, had ever before been discovered as that which they found in the microscopic study of the rocks displayed in the hundred and eighty miles of shafts and galleries at the Comstock.[1]

But the value of such technical papers can at most be appreciated only by a few. Specialists in the same field of scientific inquiry, or the prospector or miner who consults them in hope of some practical suggestion, will be their only readers, even though the results which they contain are broad and far-reaching in their significance.

Nevertheless there is connected with the development of a vast mining industry very much to awaken a popular interest. The accidental discovery of rich mineral treasures in the heart of a mountain wilderness; the rushing thither in hordes of men of every type, all eager to secure the largest prize; the human ingenuity and energy displayed in overcoming the vast obstacles which nature has placed in the way of transportation; the story of successes and disappointments, of fortunes made and lost, — all this gives scope for the display of the strongest human passions, and contains the elements of a tale whose truth is more romantic and more exciting than fiction.

In a volume[2] quite different in its character

[1] *Bulletin No.* 17 *of the U. S. geological survey.* On the development of crystallization in the igneous rocks of Washoe, Nevada.

[2] *Monographs of the U. S. geological survey.* Vol. iv. Comstock mining and miners, by ELIOT LORD; vol. vii. Silver-lead deposits of Eureka, by J. S. CURTIS. Washington, 1883, 1884. 4°.

from the other monographs which have thus far emanated from the geological survey, Mr. Lord has given an extremely interesting story of the discovery and development of what is doubtless the richest mineral lode in the world, as well as a vivid picture of the life in the town which sprung up with such surprising rapidity beside it. The book is one which can but be read with enjoyment and profit by all, no matter what their idea is of the proverbial dryness of government reports.

On the 15th of May, 1849, William Prouse, a young Mormon, travelling up Carson valley, made the first discovery that gold existed in what is now western Nevada. The region is a barren desert, occupying the eastern slopes of the Cordilleras, too arid to support more than the barest vestiges of life; and yet the report of the few grains of yellow dust discovered there by Prouse was sufficient to attract into it hosts of eager men from already overcrowded California. For ten years prospecting went on in and about what was early named Gold Cañon, with varying success. Sands were washed for gold with profit in many places, but no one as yet suspected the mine of wealth which lay at their very door. In June, 1859, Henry Comstock, a Canadian miner, secured a claim on the side of Sun Peak (now Mount Davidson), and thus impressed his name forever on the richest silver-lode ever opened. Still it was supposed that only gold was to be found, until a fortunate assay of some of the black gangue, which the miners had always thrown away as worthless, showed that it contained $3,000 in silver and $876 in gold to the ton. From this discovery (July, 1859) the development of the real richness of the Comstock may be said to date.

Nothing more was needed to start a vast tide of emigration from California to the Washoe. Over the almost impassable mountain-trail struggled, in the early spring of 1860, the wild rushing mass of humanity, without proper food or clothing. Freight-transportation was almost impossible, and into the desert they hurried, with no thought but to be first at the pile of treasure which all imagined must be awaiting them.

For a picture of the wild life of the mining-camp; of the endless litigation over claims; of the rapid growth of camp to town, and of town to city, as the mines developed; of the almost superhuman feats of energy and endurance in struggling with fire and water and in competition with each other, — we must refer the reader to the work itself. The lode proved richer at every point than the most sanguine prospector had at first imagined. Millions were spent for machinery and in draining and ventilating the mines, and yet the supplies of riches seemed endless.

In 1869 a railroad was actually constructed to this mountain fastness; and just about this time the mines, which had been increasingly productive for ten years, showed their first signs of exhaustion. Many of the old ore-bodies had almost ceased to produce. In 1872 a panic in Washoe mining-stocks ensued, which caused them again to change hands and as rapidly to bring fortune to their possessors. In 1873 was discovered the so-called 'Big bonanza.' No other such enormous mine of wealth has ever been uncovered in the earth's crust. The shafts were sunk lower and lower, but the ore only seemed to increase in richness with the depth. The silver production of the lode, which was fourteen millions in 1866, and six millions and a half in 1870, rose to over thirty-eight millions in 1876.

But of the details of this wonderful tale there is no space to enter here. For its romance and its fact alike we must refer the reader to the vivid descriptions and the statistical tables of Mr. Lord.

The work of Mr. Curtis on the silver deposits of Eureka, which lies to the eastward of the Comstock Lode, in central Nevada, is altogether different in its aim and scope from that of Mr. Lord. It is no story of mining and miners, but a clear discussion, from an engineer's point of view, of the nature and origin of the deposits, and an account of the methods by which they are worked. Only enough geology is borrowed from the forthcoming report of Mr. Arnold Hague to make the occurrence of the ore intelligible.

The deposits are large, irregular masses embedded in a limestone of Cambrian age. This is accompanied by other limestone and quartzite beds of the same and later age, and by acid eruptive rocks. The ores are mainly sulphurets of lead and silver, the former of which, however, has been oxidized down to a certain depth. The deposits occupy caverns in the limestone which they never completely fill.

The author thinks it probable that the rocks were first disturbed by dynamic forces, which crushed the limestone more than it did the other beds. Into this penetrated heated alkaline solutions, coming from below, which deposited the silver and lead sulphides as soon as the conditions of heat and pressure necessary for their solution were removed. There seems to be no evidence that the ore was derived in any way from the surrounding rocks. The only reason why it is found in the limestone is because the more shattered condition of this rock offered more opportunity for the circulation of the mineral solutions. The author also thinks that the cavities now occupied by the ore did not exist before its deposition, but that they were formed by a removal of the

limestone simultaneously with the precipitation of the metallic salts.

In chapter vi. a very interesting comparison is drawn between the silver-lead deposits of Eureka and those of Leadville and other localities in America and Europe, but no exact counterpart of these remarkable ore-bodies is anywhere discovered.

SEWERAGE AND HEALTH.

MR. ERWIN F. SMITH, in the Annual report of the Michigan state board of health, has shown the beneficial effects of thorough systems of sewerage on the health and mortality of cities. The work is based upon a large amount of data, chiefly drawn from European cities owing to the paucity and imperfection of American statistics. The author accepts the system of water-carriage as altogether the safest and best. A comparison of fifteen large cities without sewerage, with as many sewered, shows a remarkable difference in mortality. Thus in the first series the average death-rate was 35.8 per thousand inhabitants, while in the latter it was only 26. One of the most striking instances is that afforded by Chicago, where the death-rate has fallen off from 37.91 to 21.40, with the use of good water-sewerage. In the majority of cases, like results have been observed, and in only a few has the mortality remained unchanged. In England the decrease within late years in general mortality has been, perhaps, most noticeable, and in no country does sewerage receive greater attention. Most especially is there a direct connection observed between good sewerage and typhoid-fever and cholera. In Munich the mortality from the former of these causes has decreased from 1.82 to .17 per each thousand inhabitants. In Berlin, since 1879, the typhoid mortality has fallen off two-thirds; and it was further found, that, out of every 43 non-sewered houses, there was one death, as against 137 houses that were sewered. New York and Brooklyn have the best water-supply and general sewerage system of any of our large cities, and the death-rate from typhoid-fever has been correspondingly low, — in New York, during the last decade, only .28; and in Brooklyn, .15. Contrasting these figures with those of some large non-sewered cities, a remarkable difference is apparent. In Palermo and Turin, with defective water-supplies, the deaths from this cause were as many as 1.2 and .8. In St. Petersburg, without any proper disposition of sewage, the mortality was 1.06 in 1883, and .93 in 1884. It may be well to mention, that, in general, Russian mortality is frightfully high, in some provinces reaching 62 per thousand. With cholera similar results bring the conclusions that unsewered cities suffer severely, while sewered cities escape, and that localities subject to typhoid-fever are the ones likely to be visited by cholera. This last is especially significant, and behooves the earnest attention, at the present time, from American cities where the known typhoid mortality is great. As regards diphtheria, the author concludes from the study of abundant data that there is no direct relation between them. Finally, the author concludes that "it is entirely within bounds to say that the general introduction of proper sanitary measures, meaning thereby the provision of an abundant supply of pure water and the proper disposal of excreta, would reduce the annual loss in the United States from one single cause, the preventable typhoid-fever, in money value, at least $25,000,000 a year, — enough, in the course of a few generations, to sewer every city and village from the Atlantic to the Pacific."

The influence of sewerage and water-supply on the death-rate in cities. By E. F. SMITH. Lansing, *State*, 1885. 8°.

ABBOT'S SCIENTIFIC THEISM.

DR. ABBOT'S purpose is to expound a theory according to which the universe is the direct manifestation of the indwelling thought of God, — "a universe in which the adoring Kepler might well exclaim in awe unspeakable, 'O God! I think Thy thoughts after Thee,' — a universe which is the eternally objectified Divine Idea, illumining the human intellect, inspiring the human conscience, warming the human heart" (p. 214). This theory he regards as the best expression of the outcome of scientific thought, and he accordingly seeks to present his doctrine in close relation to the facts of scientific experience. Science, namely, discovers in the world objective relations, and finds these relations united in more or less completely understood groups or systems; science therefore, thinks Dr. Abbot, properly concludes that the world as a whole must be one rationally comprehensible system of relations. But a comprehensible system of relations is, he affirms, inconceivable apart from an intelligence that creates the system or that expresses itself in this system: hence the world must not only be intelligible, but intelligent; and therefore "the universe *per se* is an infinite self-consciousness" (p. 155). This, in the briefest summary, is Dr. Abbot's positive doctrine.

Organic scientific philosophy. Scientific theism. By FRANCIS ELLINGWOOD ABBOT, Ph.D. Boston, *Little, Brown & Co.*, 1885. 16°.

Nobody with the slightest knowledge of the annals of human thought ought to hesitate concerning where such a doctrine historically belongs, what line of philosophic tradition it represents, and upon what general considerations it must inevitably found itself, in case it gets any sound foundation at all. It is the well-known idealism of Plato, the immanent teleology of Aristotle, the doctrine that the continental schools of modern philosophy have from the first labored to comprehend, and to establish upon a modern foundation, the doctrine *par excellence* of post-Kantian idealism in Germany, and, in general, the contention of objective idealism everywhere: this it is that Dr. Abbot's book has somehow to present to us, and that every serious philosophic student would surely rejoice to find helpfully expounded and defended, with any new shading or emphasis, and with any new and significant method of proof. To the consistent believer in this objective idealism, the novelty of Dr. Abbot's argument must therefore lie — not in the main doctrine itself, which we all know so well and have toiled over so frequently, but in the form of the demonstration. We all are aware that science does undertake to know a real world, full of relations, and rationally intelligible; and all philosophical idealists of any significance whatsoever have been interested, ever since there were any sciences of experience, in proving at least two theses: 1°, that these sciences, in their assurance of the objective reality and thorough-going, rational intelligibility of the world, are absolutely and demonstrably right; and, 2°, that this right assurance, properly interpreted, makes of this real world of science nothing more nor less than the expression of an absolute intelligence, i.e., of an infinite spirit. This effort, we insist, all idealists of any significance have made, in their way and measure, from the first. Dr. Abbot will therefore be greeted by idealists as a welcome ally, if he adds a significant argument of his own.

As to his positive achievements, however, in this main undertaking, we feel no small disappointment. The link between that objective intelligibility of things which science postulates, and that objective conscious intelligence *in* things which Dr. Abbot, like all other objective idealists, wants to demonstrate, is a link that philosophy is bound to find if it can, but that cannot possibly be found, as Dr. Abbot at first undertakes to find it, by any bare experience of the facts of nature. The whole historical outcome of the philosophy of experience has shown that, and Dr. Abbot helps his case no whit by such scholasticism as he later employs, at the top of p. 151, where, having previously told us that scientific experience shows or postulates the universe, or the self-existent, to be 'infinitely intelligible,' he goes on thus:—

"That which is self-existent must be self-determined in all its attributes; and it could not possibly determine itself to be intelligble unless it were likewise intelligent. Self-existent intelligibility is self-intelligibility, and self-intelligibility is self-intelligence; or that which intelligibly exists *through* itself must be intelligible *to* itself, and therefore intelligent *in* itself."

All this, regarded as mere assertion, may be true, and in fact the present reviewer does most potently and powerfully believe it, although he holds it not fitting that it should be thus set down; for, thus set down, this kind of objective idealism is like sweet bells jangled, out of tune and harsh. But regarded not as bare assertion, but as argument, the statements as quoted take the form of an arrant scholasticism, and can convince nobody. Our author, in fact, only *feels* the connection between the objective intelligibility that science postulates, and the objective intelligence that philosophy seeks to demonstrate. He states this his feeling sometimes as a sort of vague inductive argument, to the effect that one has never found any thing but intelligence actually capable of making intelligible systems of things; and sometimes as a scholastic rambling from the word 'intelligible' to the word 'intelligent,' through various intermediate terms. In either form, however, the argument is unphilosophical and antiquated. The objective intelligibility of the world does indeed enable us rationally to conclude that the world contains objective intelligence; but we cannot so conclude through a mere induction, which would at once, like the old forms of the design argument, fall a prey to perfectly obvious sceptical objections; nor yet may we argue by means of a multitude of scholastic terms, and hope in that way to accomplish our purpose. We must take a little more trouble in philosophy than this. We must tread in certain paths of critical argument that Dr. Abbot, with all his idealistic enthusiasm, has studiously and very unphilosophically avoided, although many of them are very old facts in the history of idealism.

Space has forced us to be, we may fear, even discourteously brief in these remarks upon Dr. Abbot's positive doctrine; but, as to his historical and critical introduction to this doctrine, we despair of doing more than to suggest either its scope, or the thoughts that arise in us as we read it. Dr. Abbot is, on the whole, so thoughtful, so enthusiastic, so readable in spite of his terminology, so devout, so high-minded, so terribly in earnest, that it seems wicked impiety to say what

we fancy that nearly every reader of moderately good acquaintance with the history of thought will feel in going over this earlier portion of Dr. Abbot's book. Here is a scholar of undoubted learning and ability, who has himself a doctrine to advance, that, however he tries or fails to prove it, can only be described as the ancient objective idealism of the whole Platonic tradition in philosophy. He spends half his volume, however, in a violent denunciation of all idealists, whose method, he is convinced, could only lead logically to something known as solipsism. He sets over against them, as an example for their better instruction, the progressive realism of science, with its assurance that the world is there and is comprehensible, once for all. With this assurance, he thinks, philosophy must be set out, or else it must remain fruitless dreaming. The third alternative, however, the simple and obvious truth that philosophy rests neither upon an acceptance nor upon a rejection of such assumptions as this one, Dr. Abbot utterly forgets. Philosophy is in fact, at the very start, an effort to *comprehend* these assumptions of life and of science, and therefore cannot possibly begin by simply taking them as they are, unquestioned, just as it cannot possibly begin by casting them aside. It is highly comical, therefore, to find an accomplished philosophical student protesting against all writers who have ever asked *how* an individual consciousness can know a real world, and replying to their queries by the simple repetition of his personal assurance that we *do* know an external world. What, then, is philosophy there for, if not to answer, first of all, just the question, *How?* where common sense has contented itself with a bare *that?* How can a thinker of Dr. Abbot's experience be ignorant of this fundamental distinction between philosophizing about life, and living apart from philosophy? Life makes assumptions, and philosophy critically analyzes them; and that is precisely the cardinal point of difference in question. Now, empirical scientific investigation as such is just one form, though a very highly developed form, of living. It therefore does not reflect upon its own presuppositions. Why should it? But philosophizing is coming to self-consciousness about the foundation of your presuppositions. This work of merciless reflection must of course, in the beginning, take upon itself the sceptical form. Nothing is sacred to it: it is cold, dry, passionless, in spirit and in method. Yet its ultimate aim is not negation, nor yet scepticism, but clear consciousness, and nothing less than clear consciousness. Nobody is bound to pursue such an investigation unless he is so disposed; but for a professional philosopher himself to appear before us, ridiculing the very business of his art as necessarily worthless, produces a strange impression. It is as if a poet should begin by assuring us that all verse is a vain show and a wicked distortion of facts. Yet what else is all this introductory philippic of Dr. Abbot's but an abuse of the philosophers of former ages for having tried to philosophize? "The first objection to phenomenism," he writes, "is that science is actual knowledge of a noumenal universe, and therefore refutes by its bare existence" phenomenism (p. 79). "Noumenism," on the other hand, "is the only just and philosophical interpretation of the scientific method" (p. 127). The scientific method, moreover, is "the true and only organon for the discovery of truth; and the proof of its validity is the rapid progress of actual discovery" (p. 62). However, after all, "the truth of perception cannot be logically proved," as Dr. Abbot with charming simplicity remarks on p. 180, adding, "But if the wonderful increase of human knowledge by the use of the scientific method be not verification of the original scientific hypothesis [i.e., of the existence of a noumenal world], then there is no such thing as verification, and all human knowledge is a melancholy lie." These remarks are sufficient of themselves to characterize Dr. Abbot's not uncommon, but highly amusing state of mind. His philosophy thus rests upon two assertions, whereof the one is the statement that no truly fundamental philosophical reflection is needed at all, since 'the actual existence' of science is a sufficiently fundamental basis for our beliefs; while the other is the equally interesting statement that no fundamental philosophy is even possible, since "the truth of perception cannot be logically proved." The outcome of these two assertions of the uselessness and the impossibility of philosophy, is something that calls itself a 'philosophy of science,' and that announces itself as destined to revolutionize human thought about these matters. Its culmination in the 'Religion of science,' a truly beautiful and pious doctrine, for which of course it can give no sort of fundamental reason, we have already seen. In fine, then, Dr. Abbot's book gives us the positive theory that the objective idealists of the past discovered, held, and tried in a critical and thorough-going way, to demonstrate. This theory Dr. Abbot himself maintains by some very halting empirical arguments, and by a few scholastic word-puzzles. Those objective idealists of the past, however, he meanwhile fiercely upbraids, for that they, the wretches, in their tediously critical fashion, actually tried to get to the bottom of things, to discover fundamental principles, and even to demonstrate with philosophical thoroughness their positive doctrine and

his. The philosophy of the future will not act as they did, will cease to reflect upon the scientific assumptions, will take them merely on faith, with a few hints about the insanity of inquiring into them, and with a little melancholy contemplation of those dark ages when men used even to ask fundamental questions. In brief, the philosophy of the future will not philosophize.

Devotion and enthusiasm in the presence of the greater questions of religion and science are so rare that one rejoices to find any one so enthusiastic and devout as Dr. Abbot. But when he undertakes to discuss the philosophic questions proper, Dr. Abbot, by his ferocious denunciation of the whole past course of modern thought, reminds us of a certain newspaper musical critic, whose abuse of all the better concerts that he chances to attend we often have read with huge delight. The critic in question is, namely, by the will of an evil fortune, as accomplished and scholarly a musician as many years of toil could produce. Unhappily, however, it chances, that, by the will of God, his nature was so constituted that he hates music. The sorrows of this man are hard to conceive. JOSIAH ROYCE.

STOKES'S LECTURES ON LIGHT.

THE singular origin of these courses of lectures was described in this journal (vol. iii. p. 765) in the review of the first. Though by the same author as the first, the subjects treated are far more generally understood by the ordinary reader of scientific literature, and consequently hardly admit of such original treatment as characterized the former book. Of the four lectures here given, the first treats of phosphorescence and fluorescence; while the remainder, with the exception of a portion of the second lecture, which relates to the rotation of the plane of polarization, is devoted to spectrum analysis and its revelations. Perhaps the most interesting passage to the scientific reader occurs on p. 45, relating to the author's claims as an original discoverer of the principles of spectrum analysis. The warm discussions to which this topic have given rise are numerous, and, as is well known, some of the most eminent English writers have attributed the priority of the discovery, without restriction, to Stokes, leaving for Kirchhoff, beyond credit for an independent discovery, only the honor of having extended the method to the detection of elements in the sun other than sodium. Thus Tait, in his 'Recent advances in physical science,' and Sir William Thomson, in the President's address (*Brit. ass. rept.*, 1871). It was the latter which called out Zöllner's vigorous retort and arraignment of English men of science in the introduction to his 'Ueber die natur der cometen.' In this passage, after describing Foucault's observations on the spectrum of the electric arc, the author says, "On this ground, it seemed to me that the substance which exercised the selective absorption in Foucault's experiment must be free sodium. This might conceivably be set free from its compounds in the intense actions which go on in the sun or in the electric arc; but I had not thought that a body of such powerful affinities would be set free in the gentle flame of a spirit-lamp, nor perceived that the fact of that flame's emitting light of the definite refrangibility of D, entails, of necessity, that it should absorb light of that same refrangibility."

Burnett lectures on light. Second course, on light as a means of investigation. By GEORGE GABRIEL STOKES. London, *Macmillan*, 1885. 24°.

IN a recent paper by Prof. S. I. Smith (*Ann. mag. nat. hist.*) on the decapod (crabs, lobsters, etc.) crustaceans from the Albatross' dredgings in the North Atlantic, there are some interesting points brought out regarding the deep-water fauna. An unusually large number — a third — of all the species of decapods obtained were from depths greater than one thousand fathoms, and many of the species were remarkable for their large size. Specimens of one brachyuran had the carapace five inches long and six broad, while others of an anomuran were yet larger, the outstretched legs measuring over three feet in extent. Not only were there many large species, but there was an apparent absence of all small species. Their color was also found to be very characteristic. A few species were apparently nearly colorless, but the great majority were of some shade of red or orange, and there was no evidence of any other bright color. Of twenty-one abyssal species, eight possessed normal black eyes, two had abnormally small eyes, three had eyes with light-colored pigment, while of the rest the function was doubtful. Of five species from below two thousand fathoms, one had normal well-developed eyes, and the others small, imperfect, or doubtful. From these facts, in connection with others, the author concludes, that, despite the objections of physicists, some light probably penetrates even beyond two thousand fathoms; and he thinks, from the purity of the water in mid-ocean, light might reach this depth as readily as to five hundred, or even two hundred, nearer shore. However, he finds that there is an undoubted tendency towards radical modification or obliteration of the normal visual organs in deep-water species. The large size and small number of eggs were also observed as a marked characteristic of many deep-sea decapods.